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AXLE SUSPENSION FOR RIGID AXLES OF VEHICLES

Specification:

The present invention pertains to an axle suspension for rigid axles of vehicles, especially air-suspension, air cushioned or air sprung utility vehicles, in which a twistable, angulatable or torsionable four-point connecting rod, which is connected in an articulated manner to the vehicle axle, on the one hand, and to the vehicle body, on the other hand, and which is connected by two joints located at spaced locations from one another in the transverse direction of the vehicle to the vehicle axle and to the vehicle body, is arranged above the vehicle axle, at least one axle strut, which extends in the longitudinal direction of the vehicle and connects the vehicle axle and the vehicle body in a vertically movable manner, is arranged on each side of the vehicle for axle guidance, and at least one spring assembly unit is arranged between the vehicle axle and the vehicle body for springing or suspension.

Such axle suspensions of this type have been known from, e.g., DE 195 21 874. The design embodiment of such axle suspensions is, in principle, simple, space- and cost-saving, and has consistently proved successful in practice. However, such an axle suspension forming this type as well as other designs known from the prior art have the drawback that the axle is rigidly connected to the axle struts arranged adjacent to same. In conjunction with the entire axle construction, such a fastening leads to a kinematic overdetermination or redundancy, of the degrees of freedom of the vehicle chassis. This in turn leads to the course of the kinetic processes within the axle construction being undefined in certain situations, which may have an adverse effect on the coordination of the chassis and the chassis dynamics in the vertical and lateral directions.

Moreover, the kinematic overdetermination may lead to vibrations of the drive shaft with a

resulting increase in th[redacted]ear of the drive shaft and high load o[redacted] axle housing used in the case of driven axles.

The technical object of the present invention is to improve an axle suspension of this type such that the kinematic conditions are improved in order to optimize the dynamics of the vehicle movement and to achieve reduced vibrations and reduced wear as well as increased lateral rigidity of the axle construction. In addition, the number of the individual parts shall be further reduced, the ease of repair shall be increased and the unsprung or unsuspended weights shall be further reduced.

This object is accomplished according to the present invention by the technical teaching of claim 1, in conjunction with the type-forming features. According to the present invention, the axle strut shall be connected to the vehicle axle by a molecular joint. Contrary to the axle constructions known from the prior art, the articulated mounting of the vehicle axle leads to a markedly more favorable elasticity for the entire system of the axle suspension and an unambiguous assignment or association of the kinematic conditions under all driving conditions, so that the inward and outward deflections of the axle as well as the pendular behavior are not adversely affected by squeezing, or jamming, or twisting of the vehicle axle.

Special embodiments of the subject of the present invention will also appear from the features of the subclaims.

It proved to be especially advantageous, in particular, that the axle struts have a mount or support for the spring assembly unit used and/or a shock absorber. The axle struts are extended for this purpose beyond the articulation point for the end connecting the axle strut to the vehicle axle at their free end not articulated to the vehicle body, and the spring assembly unit usually arranged separately between the vehicle axle and the vehicle body in prior-art constructions is accommodated at this end. The mount or support of the spring assembly unit may have a rigid or articulated design according to the present invention, and an articulated connection additionally reduces the wear of the spring assembly unit. This functional integration leads, furthermore, to a

reduction in the number of components and thus to a reduction of the costs of the entire construction of the axle suspension even as a consequence of reduced assembly time and the stocking of a reduced number of parts. The spring assembly units can be optimally connected to the axle used due to the very simple axle design according to the present invention, and it is conceivable to arrange the axle struts in a V-shaped when viewed in three-dimensional space, which leads to an additional lateral stabilization. It is, of course, conceivable in this connection to provide the axle strut not only with a mount or support for one spring assembly unit, but, e.g., four or more spring assembly units, preferably air spring cushion elements in order to spring or cushion the vehicle axle.

To make it possible to adapt the kinematic conditions of the axle suspension to the design embodiment according to the present invention even better, it is, moreover, advantageous for the axle strut to be also fixed on the vehicle body by a molecular joint. This additional molecular joint should preferably have a stiffer joint characteristic than the vehicle axle-side molecular joint of the axle strut, because a cardanic angulation especially of air bellows used as spring elements is reduced hereby.

In addition, a clean design guiding of the parallelogram of both components is possible due to the spatial kinematics of the upper four-point connecting rod and of the lower axle strut with two joints, which in turn has a favorable effect on the overall kinematics of the axle and also offers the vehicle manufacturer ideal conditions for installation. In particular, the idea trapezoid shape guiding guarantees that the wear of the cardan universal-joint shaft is kept as low as possible.

Exemplary embodiments of the subject of the present invention will be explained in greater detail below on the basis of the drawings attached. In the drawings,

Figure 1 shows a perspective view of a first exemplary embodiment of the axle suspension according to the present invention when viewed obliquely in the front in the direction of the vehicle,

Figure 2 shows a perspective view of the axle suspension according to Figure 1 when viewed obliquely at the rear,

Figure 3 shows a top view of another exemplary embodiment of the axle suspension according to the present invention,

Figure 4 shows a sectional view of a molecular joint used for the axle suspension according to the present invention,

Figure 5 shows a perspective view of another exemplary embodiment of the axle suspension according to the present invention when viewed obliquely in the front in the direction of the vehicle, and

Figure 6 shows a view corresponding to the direction of arrow VI in Figure 5, but without the wheel of the vehicle.

Figure 1 shows the axle suspension according to the present invention on a utility vehicle chassis, not shown specifically here, which is provided with longitudinal beams 1a, 1b. The longitudinal beams 1a and 1b are arranged at laterally spaced locations from one another and are rigidly connected to one another by the crossbeams 2a, 2b. The vehicle axle 3, which is connected to the longitudinal beams 1a, 1b via a four-point connecting rod 4, is arranged under the longitudinal beams 1a and 1b. The four-point connecting rod 4 has, on the whole, four joints 5, 6, 7 and 8, and two joints 5, 6 each are fastened to the vehicle body and two joints 7, 8 to the vehicle axle. The joints fastened to the vehicle axle and to the body are arranged at spaced locations from one another in the transverse direction of the vehicle.

Figure 1 also shows that a respective side brackets 9 and 10, at the lower, free end of which a respective axle strut 11 and 12 is articulated by means of a molecular joint 13, 14 each, is fastened to each of the two longitudinal beams 1a and 1b.

A molecular joint is, in principle, a joint as is shown as an example as a ball-and-socket joint in Figure 4. The molecular joint comprises a joint ball 30 located on the inside, a housing 32 surrounding the joint ball, as well as an elastomer 31 arranged between the joint ball 30 and the housing 32. In the exemplary embodiment according to Figure 4, the joint ball 30 has a two-part design, comprising an inner, metallic joint axle 33 and an outer ball 34 consisting of elastomer, which is made in one piece therewith. In another embodiment of the molecular joint, the joint ball 30 may be made of metal as a whole or it may have a cylindrical inner part instead of a ball. Such molecular joints can be correspondingly adapted to the loads acting on the joint by selecting the elastomer arranged between the joint ball 30 and the housing 32. Moreover, recesses, which bring about a specific effect on the joint characteristics, may be provided within the elastomer and/or the housing or on the inner part of the joint at least in some areas. Thus, molecular joints may have, e.g., a reduced damping in one direction and a correspondingly greater damping in at least one direction located offset in relation thereto.

The axle struts 11, 12 articulated to the side brackets 9, 10 by means of the molecular joints 13, 14 are arranged essentially in the horizontal direction and are connected to the axle 3 according to the present invention at their ends facing away from the molecular joints 13, 14 by means of another molecular joint 15, 16 each. The molecular joints 15, 16 have, in principle, the above-described design and make it possible both to absorb longitudinal and vertical forces and angulations, force acting at an angle or cardanics, which are introduced into the chassis by the movements of the axle. Overdetermination or redundancy of the kinematic degrees of freedom is prevented by the movements of the axle, so that a more optimal forward coordination can be brought about with respect to the chassis dynamics in the vertical and lateral directions.

The view in Figure 2 shows that the axle struts 11, 12 are extended beyond the articulation point for the molecular joints 15 and 16 and have a mount 17 and 18 each for a respective spring assembly unit 19, 20 at their free ends. Furthermore, there is a connection between the axle struts 11, 12 and the vehicle body 1a, 1b via a shock absorber 35, 36 each. The extension of the axle struts 11 and 12 with the integration of the mounts 17 and 18 leads to a reduction in the number of components usually used in prior-art axle constructions and thus reduces the amount of

parts to be stocked and assembly times for the axle construc ccording to the present invention.

The top view of another exemplary embodiment of the axle construction according to the present invention in Figure 3 shows that the axle struts 11 and 12 may have a direction extending toward the middle of the vehicle from their front articulation by means of the molecular joints 13 and 14 to the end of the vehicle when viewed in a top view. Moreover, the position of the four-point connecting rod 4 as well as of its articulation points on the body and the axle can be seen in the top view.

It is, of course, possible to also use the articulation according to the present invention of the axle to the axle struts for constructions in which three, four or more such spring elements are used instead of the two spring assembly units shown and in which the spring assembly units 19, 20 are arranged in front of or behind the vehicle axle 3 when viewed in the direction of the vehicle.

An embodiment with spring assembly units 19, 20 arranged in front of the vehicle axle 3 is shown in Figure 5. The shock absorber 35 (36) is fastened to the mount 18 (17) in this embodiment and the spring assembly unit 19 (20) with an air bellows (air-suspension or air spring) is mounted on the axle strut 12 (11).

List of Reference Numbers:

1a	Longitudinal beam
1b	Longitudinal beam
2a	Crossbeam
2b	Crossbeam
3	Vehicle axle
4	Four-point connecting rod
5	Joint
6	Joint

	7	Joint
	8	Joint
	9	Side bracket
	10	Side bracket
5	11	Axle strut
	12	Axle strut
	13	Molecular joint
	14	Molecular joint
	15	Molecular joint
10	16	Molecular joint
	17	Mount
	18	Mount
	19	Spring assembly unit
	20	Spring assembly unit
15	30	Joint ball
	31	Elastomer
	32	Housing
	33	Joint axis
	34	Outer ball
20	35	Shock absorber
	36	Shock absorber